Oral Communication

Biological indicators of soil health in organic viticultures: A case study in the *Verdicchio terroir* of Matelica (Italy)

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Soil health represents the foundation for the production of healthy food. Soil conditions influence the soil capacity for agricultural production and the provision of key ecosystem services. Healthy soils are key contributors to biodiversity and are a prerequisite for sustainable development. According to van Bruggen & Semenov [1] a healthy soil can be defined as "*a stable soil, with resilience to stress, high biological diversity, and high levels of internal cycling of nutrients*". Soil biodiversity constitutes one of the main components of agroecosystems, being involved in the delivery of several essential ecosystem services such as, among others, nutrient cycling, soil formation, pest and pollution control. Thus, soil biodiversity indicators can be used by governments and farmers to monitor soil health and ecosystem functioning under various land uses and management practices.

At present, organic wine represents an emerging market that is showing a high potential for growth. There is, in fact, a growing worldwide interest and attention for environmental friendly products and sustainable agricultural practices which may ensures both the increase of profitability and the improvement of life and food safety. In this scenario, the aim of our study was to assess the long-term effects of organically managed vineyards on soil health by means of two bioindicators: ciliated protozoa and microarthropods.

Ciliated protozoa are eukaryotic microorganisms which constitutes an essential component of the soil microbial loop. By feeding on bacterial biomass ciliates play an essential role in the liberation of nutrients in the plant rhizosphere [2]. Soil microarthropods play crucial roles in regulating ecosystem processes and functions by influencing organic matter decomposition (pre-decomposers) and facilitating the microbial activity, soil porosity and water infiltration [3]. Both ciliates and microarthropods are very sensitive to changes in their habitat and fluctuations in their communities can affect the food web and the energy transfer within the soil ecosystem. Thus, the monitoring of the structure of microarthropod and ciliate communities represents a valuable tool to assess soil health and functioning.

The study was realized in the *terroir* of *Verdicchio di Matelica* (Marche, Italy), on 3 vineyard plots belonging to the commercial wine farm *Collestefano*, that were organically managed since 1992 (V92, 19 years), 1998 (V98, 13 years) and 2009 (V09, 2 years) respectively**.** In each vineyard, soil samples (0-10 cm depth) were taken every month from March to October 2011. For microarthropods, the measured biological parameters were: the Soil Biological Quality (QBS-ar) index [4], abundances of biological and euedaphic forms (BF & EF) and diversity indices. Soil

samples were collected in both disturbed (tillage) and not-disturbed (no-tillage) inter-rows**.** In this regards, the wine farm adopted an alternate management of the tractor-rows on either side of the vine row with tillage and non-tillage annual cover crop species (clover, common vetch and oats). For ciliates: abundances and diversity indices were measured and soil samples were randomly collected in the whole sampling area for a total of 3 sampling (May, June and July 2011)**.** For ciliates, the results of the multivariate analysis (Cluster Analysis and Non-metric Multidimensional scaling) seem to indicate that the most stable habitat for ciliates is represented by the *older* V92 followed by the V98 and the V09 vineyards. For microarthropods, the comparison between tilled and no-tilled inter-rows in the vineyards V92, V98 & V09 by mean of QBS-ar values and abundances of FB and EF, shows that exsclusively in the oldest V92 vineyard no significant differences were detected between the tilled and no-tilled inter-rows with respect to QBS, EF and BF values by the non parametric Kruskal-Wallis (K-W) test. On the contrary, significant differences between the two differently managed inter-rows were detected for the V98 & V09 vineyards. Thus, and in agreement with ciliate indications, in the V92 the microartrhopod communities remain more stable than in the other vineyards irrespective of the type of disturbance applied (tillage).

Overall, our analysis shows that the biological communities experience less fluctuations (>stable) in the "older" vineyards compared with the "younger" V09 vineyard (V92>V98>V09). As reported also by other authors [4-5], this effect may be due to the greater resilience of the soils of the vineyards V92 and V98 possible achieved during the long term organic management. In final, this study helps in evaluating the long term effects of common organic vineyard floor management practices as well as, in the definition of possible biotic baseline values to evaluate soil health in vineyards. Furthermore, and in agreement with the guidelines of the European Commission and the Food and Agriculture Organization (FAO) of the United Nations, our study contribute to raising awareness among stakeholders and policy makers on the importance of soil biodiversity in preserving soil health (and food safety) and in assisting them to select, promote and stimulate adequate sustainable farming practices by which to reduce the environmental impact of agriculture and move the world toward a more sustainable food future.

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